

CLAIMS

What is claimed is:

- 1 1. A method for cleaning silicon carbide materials on a large scale, the method
2 comprising the acts of:
3 using an integrated system that is adapted for handling a multiplicity of said
4 silicon carbide materials during said cleaning;
5 ultrasonicating said silicon carbide materials in an aqueous solution of
6 inorganic acid; and
7 ultrasonicating said silicon carbide materials in a bath of deionized water.
- 1 2. The method of Claim 1, wherein said silicon carbide materials are sintered.
- 1 3. The method of Claim 1, wherein said silicon carbide materials are formed
2 using chemical vapor deposition (CVD).
- 1 4. The method of Claim 1, further comprising the act of oxidizing said silicon
2 carbide materials.
- 1 5. The method of Claim 4, wherein the act of oxidizing comprises using a
2 temperature from about 800 degrees Celcius to about 1500 degrees
3 Celcius.
- 1 6. The method of Claim 1, further comprising the act of scrubbing said silicon
2 carbide materials.
- 1 7. The method of Claim 6, further comprising the act of contacting said silicon
2 carbide materials in a dilute aqueous solution of inorganic acid after
3 ultrasonicating said silicon carbide materials in said bath of deionized
4 water.

- 1 8. The method of Claim 1, wherein said aqueous solution of inorganic acid is
2 selected from said group consisting of HF:HNO₃:H₂O and HF:H₂O₂:HNO₃.
- 1 9. The method of claim 1, wherein said aqueous solution of inorganic acid
2 comprises:
3 5%-20% wt. HF;
4 20%-95% wt. HNO₃; and
5 0%-80% wt. H₂O.
- 1 10. The method of claim 1, wherein a temperature of said aqueous solution of
2 inorganic acid is maintained from about 20 degrees Celcius to about 50
3 degrees Celcius.
- 1 11. The method of claim 1, wherein the act of ultrasonicing said silicon carbide
2 materials in said aqueous solution of inorganic acid is performed for a
3 duration of time from about 10 minutes to about 15 minutes.
- 1 12. The method of claim 1, wherein the act of ultrasonicing said silicon carbide
2 materials in said aqueous solution of inorganic acid is performed at a power
3 from about 30 watts per gallon to about 50 watts per gallon.
- 1 13. The method of claim 1, wherein the act of ultrasonicing said silicon carbide
2 materials in said aqueous solution of inorganic acid is performed at an
3 ultrasonic frequency from about 25 Kilo-hertz to about 40 Kilo-hertz.
- 1 14. The method of claim 1, wherein the temperature of said bath of deionized
2 water is maintained from about 20 degrees Celcius to about 50 degrees
3 Celcius.

- 1 15. The method of claim 1, wherein the act of ultrasonicing said silicon carbide
2 materials in said bath of deionized water is performed for a duration of time
3 from about 30 minutes to about 61 minutes.
- 1 16. The method of claim 1, wherein the act of ultrasonicing said silicon carbide
2 materials in said bath of deionized water is performed at a power intensity
3 from about 80% to about 90% of 40 watts/gallon.
- 1 17. The method of claim 1, wherein the act of ultrasonicing said silicon carbide
2 materials in said bath of deionized water is performed at an ultrasonic
3 frequency from about 27 Kilo-hertz to about 40 Kilo-hertz.
- 1 18. The method of claim 1, wherein the act of ultrasonicing said silicon carbide
2 materials in said bath of deionized water is performed at a power from about
3 30 watts per gallon to about 50 watts per gallon.
- 1 19. The method of Claim 1, further comprising the act of baking said silicon
2 carbide materials.
- 1 20. The method of Claim 19, wherein the act of baking comprises using a
2 temperature of about 200 degrees Celcius to about 300 degrees Celcius.
- 1 21. The method of Claim 19, wherein the act of baking is performed for a
2 duration of time from about 2 hours to about 3 hours for silicon carbide
3 wafer-rings and silicon carbide wafer-lift pins.
- 1 22. The method of Claim 19, wherein the act of baking is performed using a
2 nitrogen purge oven.

- 1 23. The method of Claim 19, wherein the act of baking is performed using a
2 convection oven.
- 1 24. The method of Claim 19, wherein the act of baking is performed using a
2 vacuum oven.
- 1 25. The method of Claim 1, further comprising the act of purging said silicon
2 carbide materials in a nitrogen gas stream.
- 1 26. The method of Claim 25, wherein the act of purging said silicon carbide
2 materials in said nitrogen gas stream is performed at a pressure from
3 about 10 psi to about 20 psi.
- 1 27. The method of Claim 1, further comprising the act of soaking said silicon
2 carbide materials in said aqueous solution of inorganic acid.
- 1 28. The method of Claim 27, wherein said aqueous solution of inorganic acid
2 is selected from said group consisting of HF:HNO₃:H₂O and
3 HF:H₂O₂:HNO₃.
- 1 29. The method of claim 27, wherein said aqueous solution of inorganic acid
2 comprises:
3 5%-20% wt. HF;
4 20%-95% wt. HNO₃, and
5 0%-80% wt. H₂O.
- 1 30. The method of claim 27, wherein a temperature of said aqueous solution of
2 inorganic acid is maintained from about 20 degrees Celcius to about 50
3 degrees Celcius.

- 1 31. The method of Claim 7, wherein said dilute aqueous solution of inorganic
2 acid is selected from said group consisting of HF:HNO₃:H₂O and
3 HF:H₂O₂:HNO₃.
- 1 32. The method of claim 31, wherein said dilute aqueous solution of inorganic
2 acid comprises
3 0.5%-1.5% wt. HF;
4 1%-10% wt. H₂O₂; and
5 0.1%-0.5% wt. HNO₃.
- 1 33. The method of claim 7, wherein a temperature of said dilute aqueous solution
2 of inorganic acid is maintained from about 20 °C to about 50 °C.
- 1 34. The method of claim 1, wherein said integrated system includes chemically
2 resistant materials that are flexible.
- 1 35. The method of claim 1, wherein said integrated system includes robotic
2 mechanisms.
- 1 36. The method of claim 34, wherein said chemically resistant materials includes
2 high-density polyethylene.
- 1 37. The method of claim 1, wherein said integrated system is adapted for
2 handling silicon carbide wafer-lift pins.
- 1 38. The method of claim 37, wherein said integrated system includes one or
2 more a pin-racks adapted for holding said silicon carbide wafer-lift pins.
- 1 39. The method of claim 1, wherein said integrated system is adapted for
2 handling silicon carbide wafer-showerheads.

- 1 40. The method of claim 1, wherein said integrated system is adapted for
2 handling silicon carbide wafer-rings.
- 1 41. The method of claim 40, wherein said integrated system includes one or
2 more wafer boats adapted for holding said silicon carbide wafer-rings.
- 1 42. The method of claim 1, further comprising using a peristaltic pump and a
2 manifold for cleaning interior surfaces of hollow silicon carbide wafer-lift pins.